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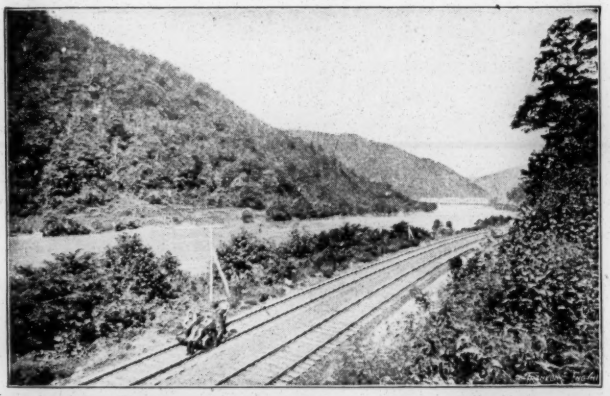

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THE

National Geographic Magazine

VOL. IX JULY, 1898 No. 7

AMERICAN GEOGRAPHIC EDUCATION

By W J McGEE,

Vice-President of the National Geographic Society

The Capital of the Nation gives greeting to the National Educational Association. The American Republic, more than any other nation, owes character to knowledge diffused among its people; and in no other nation is the diffusion of knowledge so broad and general. This diffusion of knowledge involves education, and the development and maintenance of educational institutions. In accordance with the plan of government by the people, of the people, and for the people, our educational facilities are brought within reach of every citizen, our educational methods adapted to the needs of the masses. Some governments strive to build intellectual structures from the top downward, only to find their lower bricks on a foundation of sand; our system is founded on the rock of popular education, and the upper portions of the structure are left free. Therein lies a fundamental distinction, the diametrically opposed nature of monarchic policy and republican policy in educational matters. Under the republican system the twig is bent—the youthful mind is started aright; thenceforth it grows and strengthens spontaneously, and in good time gives strength to the Republic. Other nations cramp thought and enslave minds by Procrustean systems based on the knowledge of previous generations, while our nation plants the seeds of knowledge to be supported by its fruits, and so rises constantly to higher and higher planes with a rapidity unprecedented in history; our state does not so much shape education as our education shapes the state. Yet the in-

terest of the state in the progress of education is not diminished but only increased by this national policy; and so the National Capital welcomes the educators of the nation more warmly than the wise men of any other nation would be welcomed in their capital; and the welcome is only the warmer still because the organization of educators is voluntary and spontaneous.

The National Capital is not without educational facilities and agencies. As the nation grew, inquiries concerning resources and the conditions of material development became necessary, and offices of inquiry were created. Several of these offices have grown into bureaus and departments, constantly at work not only in increasing but also in diffusing knowledge—*i. e.*, they have become educational institutions of the highest order. As the offices grew, experts and makers of knowledge were assembled until the National Capital became a center of practical learning. In time the experts voluntarily met for mutual benefit and grouped themselves in unofficial organizations, which now stand in the front rank of learned societies of the world; and official bureaus and unofficial societies are one in purpose, and that the highest within human reach—the increase and diffusion of knowledge for human weal.

The unprecedented growth of our national institutions of practical learning has been due to several causes, but especially to two—the freedom and spontaneity of knowledge under republican conditions, and the vast extent and varied resources of the national domain. Particularly influential has been our national bigness. In the first place geographic ideas are daily developed through that current news which is one of the features of American life; in the second place engineers and surveyors have found full scope for their talents, and have come to lead the world in railway-laying, bridge-building, and the invention of innumerable attendant devices. Then the resources of our rocks have stimulated geologists, and the science has advanced with such giant strides that today the geology of the world is shaped in America. At the same time our broad territory is so conditioned with respect to continental features and sources of aqueous vapor that our meteorologists have been inspired to lead the world in weather science. So, too, our ethnologists and anthropologists have profited by the unequalled opportunities found in the assemblage of peoples and in the range of culture-grades from savagery to enlightenment, which it is theirs alone to survey, and have reconstructed the science

of man on a higher plane than is known abroad. Thus America has outstripped the rest of the world in scientific development, especially during the last quarter-century, and while the progress has gone forward at equal rate in every part of the land its center is the National Capital, where the federal offices and several of the scientific societies are located; and the assembling of our educators in our Capital City is a fitting conjunction which must benefit both.

The largest learned body domiciled in the Capital City is the National Geographic Society. Although the major portion of its members are residents of the District of Columbia, it has a membership distributed over all of the states and territories, especially in the leading educational institutions. The express function of the Society is "the increase and diffusion of geographic knowledge." These ends are attained by means of public meetings for the presentation and discussion of communications, by the publication of a magazine, and in other appropriate ways. It is, in the best sense of the term, an educational institution; and the success of its work is attested by its unprecedentedly rapid growth in membership and influence.

The National Geographic Society is among the institutions of the National Capital striving to render the meeting of the National Educational Association agreeable and profitable. It has secured the coöperation of the scientific bureaus in the preparation of an exhibit illustrating the work of the federal government in knowledge-making, and indicating the educational facilities of the Capital; this exhibit is installed in the Central High School building, and will be in immediate charge of custodians able to explain the maps, apparatus, and other objects exhibited, and to describe the work of the bureaus. It has arranged a field-meeting in the interest of the Association, at which the methods and purposes of the Society will be illustrated by addresses on phases of geography by the leading living specialists. It has devoted a special number of THE NATIONAL GEOGRAPHIC MAGAZINE to the Association, and provided for its sale to members at a fraction of the customary price. Finally it was one of the institutions of the National Capital to cordially invite the educators of the country to Washington; its officers and members are serving on local committees and contributing in other ways to the convention; and it stands second to no institution in welcoming the educators of America to the fair city by the Potomac which has become the world's center of enlightenment.

ORIGIN OF THE PHYSICAL FEATURES OF THE UNITED STATES*

By G. K. Gilbert,

United States Geological Survey

Fifteen years ago, on a September morning, I stood on a housetop in Zuñi, waiting for the rising of the sun. On other housetops here and there were other watchers, sitting or standing with their faces toward the east, and close at my side stood a venerable priest of the Sun, oblivious of all else and gazing intently on the spot where the sun should appear. From his neck hung a small bag containing sacred meal. When the first streak of light appeared above the eastern mesa his lips began to move, and he repeated slowly and with low voice an invocation to the Sun. Then, taking from the bag a small offering of the consecrated flour, he breathed upon it and cast it toward the east. Cushing, who became a Zuñi Indian that he might learn their lore, tells us that this sun-rise ritual contains archaic words of which few modern Zuñis know the meaning—words related to the modern Zuñi tongue as Norman French to modern English, and showing that the Zuñi sun-worship began in remote times, far beyond the possibility of historical determination.

The Zuñi's reverence for the sun-god is shared by many savage tribes, and belongs to the early history of many civilized peoples. In later stages of culture it is succeeded by the worship of animals, of the personified powers of nature, and of personified mental power, so that with civilized man the old sun-worship has disappeared; but there is a new sun-worship, introduced and fostered by science, for science has discovered in the sun a creator of wonderful versatility and power.

Geographers worship also another nature-god, the inner earth or the underground, a creator also and co-worker with the sun. These two gods of physical geography were known to the Greeks as Helios and Hades, to the Romans as Apollo and Pluto. In

*The course of afternoon lectures arranged for the winter and spring of 1898 was planned by the late President Hubbard to present the effect of geographic environment on the civilization and progress of the United States. The present essay was prepared at his request as the introductory lecture of the course, dealing with general principles and the most comprehensive groups of natural features.

later centuries Apollo, as the stimulator of life, developt into the god of culture; but to early tradition he is the sun, a nature-god coördinate with Pluto, the underground. Geology has long recognized Pluto, but has made him coördinate with the sea-god, Neptune, naming her rocks in two great groups, the plutonic and neptunian. Neptune has place also in the pantheon of geography, but only as a vassal of the mightier Apollo.

Apollo gives to the earth light, heat, frost, storm, and rivers, and is daily the creator of motion and life. Pluto is an unknown god, hidden and mysterious. The Greeks named him Hades, the unseen. His only attribute of which we are altogether sure is heat. Imagination pictures him in various ways, but imaginations differ, and their conflicting sketches need not claim our attention today. He made the continent and is never tired of remaking it. But for him the globular earth would be envelopt in an endless ocean, and life would be far different from the life we know. By ridging the outer rind of the earth he created the land and set a limit to the sea, and from age to age he swells broad land tracts upward or draws them downward, so that the outlines of sea and land are ever changing. Crushing the rock together here and there, he forces up mountain ridges; fusing it, he pours out lavas that congeal and build up other mountains.

Apollo dips up water from the sea and sprinkles it on the rock to moisten and soften it. By alternate heating and chilling he cracks it into bits; and by a complex chemistry which, despite our studies, still seems magical, he changes it to fine soil, in which plants may grow and in which the husbandman may delve. Lifting more water from the sea, he pours it broadly on the land to make rills and rivers, which wash the soil away, spreading it in the hollows and building plains. This scouring cuts the uplands into hills, but eventually they, too, are worn down, so that the plain is the end and aim of the water work. Preparing for the plow the yielding soil and level surface which make its labors light, and showering the fields with fertilizing moisture, he is the beneficent patron of agriculture.

The mountains of Pluto, lifted to the region of clouds, intercept and engender storms and are the perennial sources of streams. Rugged with gorges and crags and scantily clothed with soil, they extend no welcome to the farmer, but instead they harbor a forest growth, storing timber and fuel; and in some lands their huge banks of winter snow are reservoirs for the water of irrigation.

Pluto and Apollo separate the earth stuff into kinds. If all

the minerals of the land were mingled in one complex but homogeneous substance, the problem of civilization would be a problem of separation and would be chemical; but the gods have classified and arranged, sorting the more abundant materials into broad layers, and gathering the rarer into crevices and pockets; and so the problem of civilization is a problem of exploration and discovery, or a problem of geographic distribution.

Pluto sorts by creating a slow circulation of water. As far as mines and borings have penetrated the earth the pores of the rocks are full of water, and the downward limit of this saturation is unknown. The upper rocks are comparatively cool; the lower rocks are hot; and the contrast sets the water in motion. The upper water, denser because cold, tends downward; the under water, expanded and made lighter by heat, is forced upward, and though motion is exceedingly slow, there is a continuous circulation. The chemistry of the upper water is different from the chemistry of the lower. Each can dissolve certain substances, but the substances are not the same. The properties of water change as heat and pressure increase, and again as heat and pressure decrease. So the slow-moving water picks up certain substances in one region, and in another deposits them so as to receive other substances, and in this way it sorts out many of the rarer things, gathering together or concentrating ores of gold, silver, platinum, mercury, lead, zinc, copper, and iron.

Apollo sorts by the free circulation of water at the surface. The soil that is washt away from mountains and uplands and spread by the streams in lowlands and submerged plains is not deposited in one promiscuous mass, but is classified according to kinds—marl in one place, clay in another, and sand in another—and in time these become limestone, shale, and sandstone. The tissues of plants are gathered in swamps and changed to peat, then buried under shale and sandstone, and finally transformed to coal. The tissues of plants and animals, intimately mingled with mud that changes underground to shales, are slowly distilled in after ages to fill rock reservoirs with oil and gas. In other places and by other special processes iron, salt, gypsum, and phosphates are separated; and where Plutonic stores of the metals are ravaged by storm and stream, the gold is separated by its weight and gathered in the river gravels.

The origin of the features of all lands having been thus briefly sketcht, we may now consider in a broad way the physical

THE UNITED STATES IN RELIEF, SHOWING THE PRINCIPAL PHYSICAL PROVINCES

Photographed from a model prepared for the U. S. Geological Survey by Edwin E. Howell

characters of the United States, and for this purpose it is convenient to divide the country into a few broad provinces.

Parallel to the Atlantic coast is the Appalachian Mountain belt, running northeastward from Alabama to New England. East of it lies the Atlantic plain. West of it the Central plain, consisting largely of the valley of the Mississippi, stretches to the base of the Rocky mountains. Thence to the Pacific coast is a mountainous province known to geographers as the Cordilleras. A fifth province, the province of the Lakes, overlaps the northern portions of the other four and reaches from ocean to ocean along our Canadian border.

The Cordilleran province, comprising the western third of our country, is characterized by mountain ranges. The dominant trend is with the meridian, swerving in some districts toward the southeast, and in others toward the southwest; and in each district there is a general parallelism. The ranges are definitely Plutonic, each one having been caused by a distinct local uplift; but they are not altogether independent, for there is much evidence of system in their arrangement. Not only are neighboring ranges approximately parallel, but they are evenly spaced, so that in crossing the system one finds a regular alternation of ridge and valley. Through extensive districts the alluvial waste from the erosion and sculpture of the ranges is gathered in the intervening valleys, making of each one a shallow basin or gently concave plain, where roads may run at will. Here and there some of the lower ranges are almost buried by the alluvial filling, so that their summits project as craggy islands above a sea of rock waste. Elsewhere, and especially where the mountains are highest, the intervening valleys are drained by vigorous rivers, which carry off the waste and prevent the building of extensive plains. In one important district uplift has not completed its work of mountain-making, and the land forms a system of plateaus of various heights, through which the Colorado and its tributaries have carved their wonderful system of canyons. Volcanoes, also, have made extensive contributions to the topography, building many great cones and a multitude of cratered hills, and adding voluminous beds of lava to the alluvial strata of the valleys.

In the extreme northwest the rainfall is exceptionally abundant, causing a forest growth so luxuriant and dense that the farmer cannot afford the labor of its subjugation as the purchase price to Nature for his land. Much of this district, also, is too rugged

Photograph from a model prepared for the U. S. Geological Survey by Edwin E. Howell

for the plow, so that it constitutes a great natural forest reserve, needing only protection from fire to insure a perpetual supply of timber. In the remainder of the province the rain tribute is scant, falling far short of the farmer's needs, so that crops must be irrigated. The downfall is greater on mountains than on valleys, and about their cool summits the winter's snow lingers through spring and summer, doling out water to mountain streams, which may be utilized for the irrigation of valley lands. But the acres which can thus be nourisht are only a small share of those whose smooth surface invites the plow, and the valleys as a whole belong to the herdsman rather than the husbandman. Their grasses are scant, but this fault is half compensated by their immense extent, and they must be counted as a valuable resource, an important reserve of grazing land that can never be monopolized by agriculture. On the higher plateaus and in the recesses of the mountains are tracts and patches of forests, many of which are protected against hasty consumption by inaccessibility, and these supplement the great reserve of the extreme northwest. In the mountains, also, are Plutonic stores of the precious and other metals, and a score of valleys hold Apollonic magazines of coal. The mountain streams, in addition to their tribute to agriculture, afford power to the manufacturer. Untamed and fickle, subject to enormous floods and irregular droughts, their control is not easy; but if they shall ever be subdued and harnest, there is hardly a limit to the tasks they may perform.

The Central Plain, comprising half of all the land, has been shaped by Apollonic forces. The geologist tells us of many uplifts, dislocations, and flexures of the crust; but all these have been reduced to approximate evenness by the coöperative work of rain, frost, and rivers. Where hollows were made they have been filled; where hills and mountains had grown they have been pared away, so that only their roots, with a few low stumps, remain. In types of detail there is much variety, and there are many rugged tracts; but the characterizing feature is evenness, and agriculture is the great industry for which the province is naturally destined.

On this broad fact, however, climate imposes an important qualification. Over most of the province the spring and summer rains suffice for the farmer's need, disappointing him only by an occasional drought, but in a western belt following the base of the Rocky mountains, and including much of the sub-province known as the Great Plains, the rainfall is so scant that agricul-

ture must depend on irrigation, just as in the Cordilleras. Here, again, grazing may flourish without need to compete with agriculture for possession of the land, and the domain of the herdsman is thus naturally set apart.

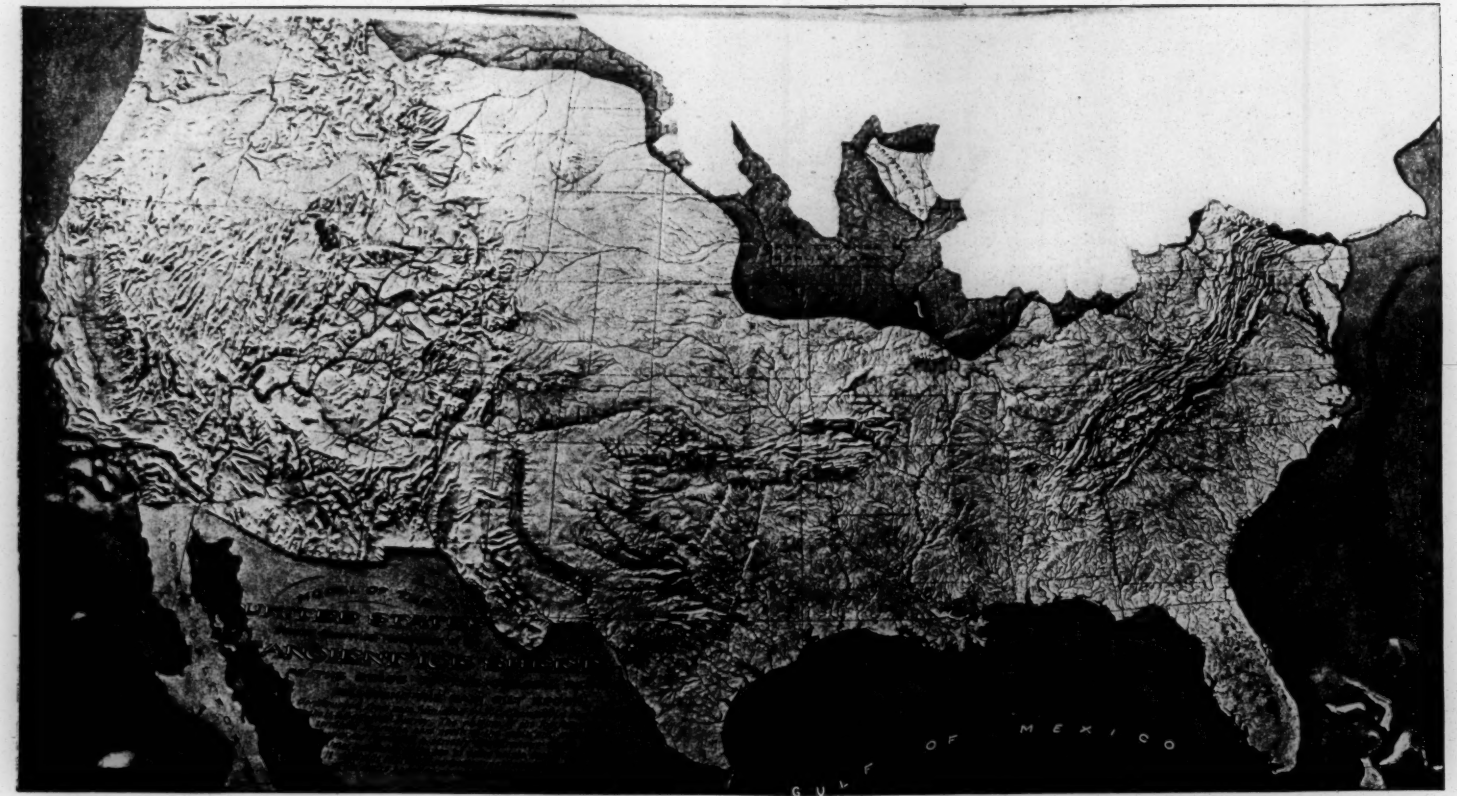
Of the rarer mineral resources the Central Plain has greatest wealth in coal, which underlies broad tracts and is easily mined. It is rich also in iron, both Plutonic and Apollonic, and has abundant salt and gypsum. Throughout its broad extent wagon roads and railroads are easily constructed, and its grain for export finds cheap water transportation from interior districts to the sea by way of the Mississippi and the St Lawrence.

The mountains of the Appalachian Province were formed by the coöperation of Pluto and Apollo. Long ago the crustal rocks were crowded together in a great system of wrinkles, the crests of which were then wholly pared away so that the Central and Atlantic plains were joined in one. Then came other disturbances along the folded belt, but without new folding. The plain was locally lifted into a long plateau, with gentle slopes on either side, and from this plateau the mountains have been carved. Through the remnants of the old truncated folds ran long outcrops of various and diverse rocks, trending northeast and southwest, and these rocks have been wasted unequally by the eroding waters. Where there were soluble limestones or weak shales, the streams opened valleys; where there were resistant sandstones or quartzites, mountain ridges were left; and so the Appalachian ranges are a complex cameo of Nature's carving. The broader valleys were smoothed in the carving and prepared for agriculture, the mountains left rough and reserved for forest. The region is rich in iron, both Apollonic and Plutonic, and peculiarly rich in what may be called Plutonic coal—coal made, indeed, by Apollonic processes, but converted to rich anthracite by Plutonic heat. Water power is abundant, and though less magnificent in its possibilities than the power associated with the loftier Cordilleras, of greater present value because more tractable, and because associated with tillable plains that are qualified by climate for the primary industry of agriculture.

The Atlantic plain resembles the Central in that both cutting and filling have contributed to its formation, but the constructive factor is here more important. While the Appalachian folds were being reduced, part of the waste went eastward, burying the Atlantic margin of the continent and extending it seaward. Later, when the Appalachian cameo was carved, the accumulation of

waste was continued, and so the eastern part of the Atlantic belt is what geographers call a constructional plain. But there is another part, lying close to the mountains, which shared in the Appalachian uplift and also in the Appalachian carving, and was finally reduced so nearly to sea level that it constitutes an inseparable part of the Atlantic Province. It consists of ancient rocks, graded down nearly to a uniform level, and is clast by geographers as a destructional or eroded plain. As Pluto raises and lowers the land the ocean is caused to alternately recede and advance, and this low-lying plain is peculiarly susceptible to its encroachment. In our day the fourth part of it is submerged, so that its actual limit as a physical feature lies many miles beyond the coast, where there is an abrupt change from shallow soundings to abyssal depths. The land of the Atlantic Plain is shaped for agriculture, and much of it is cultivated; but there are broad tracts of soil too poor to compete with the fertile land of the Central Plain and utilized only for timber and other forest products. Water powers, afforded by the moderate fall of large streams, have great value by reason of their proximity to tidewater and consequent facilities for cheap transportation of the raw materials and the products of manufacture.

The Lake Province, overlapping all other provinces from the north, is a marginal overflow of Canadian topography, and resulted from the great prehistoric invasion of our land by Canadian ice. The colossal ice-sheets of the eastern and central British provinces and the contemporary glaciers of the northern Cordilleran mountains remodeled the topography of all the provinces, carving the valleys into new shapes and heaping the débris in irregular mounds and ridges of peculiar type. When the ice was melted and rains fell again upon the land, the streams could neither find nor follow their old courses, and the waters were compelled to fill many a hollow before they could flow away at all; so while the old types of mountains and plains remained as broad features characterizing the several provinces, there was added the feature of obstructed drainage, markt by a multiplicity of lakes. Of these are the lakes and ponds of New England and New York, the great Laurentian lakes and their host of associated lakelets, the mountain lakes of Idaho and Montana, and the curious linear lakes of northern Washington. The distribution of ores was not affected, though facility of discovery and exploitation was locally modified, being partly impaired and partly improved. The surface conditions bearing on agri-



THE SOUTHERN PART OF THE PREHISTORIC CANADIAN ICE-SHEET. A DARK TINT SHOWS THE EXTENT AT AN EARLY STAGE. THE LIGHT TINT SHOWS A LATER STAGE, OF GREATER IMPORTANCE IN MODIFYING GEOGRAPHIC DETAILS

Photographt from a model. The glacial data are on the authority of T. C. Chamberlin

culture were greatly changed. Large tracts denuded of soil were relegated to the growth of timber; others were made hilly by the heaping of drift, and yet others were smoothed by sedimentation in the beds of temporary lakes. The new soils have a special quality as compared to those resulting from the decay of rocks, for rock decay involves leaching and the loss of soluble minerals. The ice-mill ground together unleacht samples of many rocks and deposited them with little sorting, so that the glacial soils are often rich in materials which elsewhere need to be artificially supplied.

The confusion of drainage has yielded results as important in their way as those from the traditionary confusion of tongues at Babel, for the disconcerted streams, having their descent arrested by basins and lakes, are compelled elsewhere to tumble down rapidly, making convenient water powers; and these water powers have special value because the associated lakes are natural reservoirs, protecting them from flood and drought. As the greater lakes are also natural avenues for commerce, the province of the Lakes, associating water power with commercial facility, is the natural home of manufacture.

The physical characters which, after mineral resources and climate, have greatest influence on industrial activities are internal routes for commerce and maritime harbors in their relation to external routes. The lines followed by pioneer settlement as well as those to which internal transportation ultimately adjusts itself are greatly influenced by topographic configuration, continuous mountain ranges acting as barriers and low passes through ranges serving as avenues. Long lines of navigable water also have their influence, and for districts whose most practical product is so abundant as to yield a surplus for exportation facility of transportation means progress in population and wealth. The consideration of these conditions is attractive, but as they affect various localities unequally their discussion may properly be left for the lecturers who are to speak of more limited districts.

Harbors, however, though their local quality has local value, are of primary importance to the country as a whole and may be considered today. They are naturally formed in many ways, but only the principal types need be mentioned. Wherever a river reaches the sea the continuous contour of the coast is broken, and there would be a natural harbor but for the opposition of the waves. The outflowing river endeavors to scour a channel

through which ships may enter. The waves, buffeting the coast and drifting sand and gravel to and fro, endeavor to clog the riverway with submerged bars, making the water too shoal for shipping. Over small rivers the waves are victorious, and unless engineers coöperated with the rivers the entrance-ways are sealed. Large rivers overpower the waves and clear their channels faster than the waves can clog them. Only one of our rivers, the Mississippi, has proved competent to maintain its channel to the sea, but that affords a harbor of peculiar value, in that it is connected with a system of inland navigation hundreds of miles in extent.

The fiord harbors associated with prehistoric ice-fields are an important group. The ice descended to the shores of both oceans, and by its remodeling of the surface left steep slopes with a tortuous contour, creating a great abundance of deep harbors. New England at the east and Washington at the west are thus endowed, and their maritime commerce requires neither piers nor dredges to maintain its natural channels.

Natural harbors of a third class are connected with vertical movements of the land. When the margin of the continent is lifted the coast line, following a slope new-risen from the sea, is a simple contour on an even plain, and there are no harbors; but when the land is deprest the sea-water enters each valley of the coastal plain, making a bay. Then the waves, driving sand and other land waste along the coast, build a spit across the mouth of each bay, converting it into a sheltered harbor, whose entrance is scoured four times a day by the incoming and outgoing tide. Into the estuaries thus formed the streams build deltas, gradually filling and obliterating them; but so long as subsidence continues they remain open and available for commerce. It is our good fortune that nearly the whole of our coast, both Atlantic and Pacific, is now subsiding,* so that estuaries are numerous and the maintenance of serviceable harbors requires only moderate aid from the engineer. The bays and sounds of San Francisco, Galveston, Mobile, Tampa, Savannah, Charleston, Wilmington, Pamlico, Chesapeake, and Delaware are of this type; and the Hudson estuary, which is also a fiord, carries tidewater one hundred and fifty miles from the coast.

Climatically the United States lies within the zone of variable winds. Instead of being swept by continuous trade winds or

*Strictly speaking, the determined fact is that the relation of land to sea is changing, and we do not know which one actually moves.

periodic monsoons, it is traverst at short but irregular intervals by the broad air whirls called cyclones, which bring with them rapid alternations of warmth and coolness, sunshine and rain, breeze and calm; and the direction of the wind is continually shifting. In other words, we are endowed with weather instead of mere climatic monotony.

In all parts of our land there is so much of winter that man must provide himself with clothing, shelter, and fuel. Natural fruits, to be had for the plucking, will not sustain him, and he is compelled to earn his food. Thus Nature forces him to labor and to contrive, and his physical and intellectual faculties are developt, like the athlete's muscle, by exercise. From variety of configuration, of mineral resources, and of climate, flow varied and complementary industries. Agriculture flourishes in the Atlantic and Central provinces, on the morainic hills and lacustrine plains of the Lake district, and, with irrigation, in intervales of the Cordilleras. Its products range from the hardy apple to the frost-shunning banana. Along the western borders of the Central plain and in Cordilleran valleys the herdsman tends his bands of horses, kine, and sheep. In the humid northwest, in the recesses of the mountains, and on tracts of inferior or scanty soil are forests for the lumberman. In mountains and roots of mountains are ores for the miner, and from the hills he draws fossil fuels. Manufacture finds natural power in waterfall, coal, and gas, and the way of commerce is made easy by the harbors of the coast. Thus Pluto and Apollo have prepared the land for that diversity of product and industry which gives national independence and have provided a commercial facility which joins us to the brotherhood of nations.

GEOGRAPHIC DEVELOPMENT OF THE DISTRICT OF COLUMBIA

By W J McGee

The District of Columbia lies on the boundary between two great natural districts or provinces, the Piedmont plateau and the Coastal plain.

The Piedmont province is a low plateau composed of ancient crystalline rocks, extending westward to the Blue Ridge and stretching far northeastward and southeastward. This plateau is trenched by Potomac and other rivers and their tributaries,

and its surface has been carved into hill and vale, broad divide and narrow valley, by the action of running water. During the ages past it was a high plateau or mountain range, which was first canyoned and afterward carried away by the Potomac and neighboring rivers of eastern United States.

The Coastal province is a broad lowland made up of sedimentary formations. It extends from the capital to the coast, and thence as shallow sea-bottom for over a hundred miles into the Atlantic, ending in a steep slope toward the ocean-depths; and it stretches northward to New York and southward to the limits of the continent. Thus the Coastal plain is about half land and half sea-bottom. Through the land portion broad estuaries pass, bearing the waters of Potomac and other rivers to the sea; and in the bottoms of the estuaries and in the sea-bottoms beyond, certain channels have been revealed by soundings.

The history of the development of the region may be read from the land-forms of the two provinces, and from the sedimentary formations or deposits of the Coastal plain.

DEFINITIONS

The student of geographic development takes note of (1) processes or agencies, and (2) products. The chief agency concerned in making this region is water, and the chief processes are (*a*) erosion, and (*b*) transportation by running water, together with (*c*) deposition of the transported material in slack water; or, in more general terms, degradation and subsequent aggradation.

When a considerable area of earth-crust rises in such manner as to transform smooth sea-bottom to dry land, certain changes are wrought on the surface: When the rains fall, a part of the water lies long on the level surface and forms marshes, but here and there rivulets form and flow down the gentle slopes toward the sea; the rivulets cut rills and, as the waters gather strength with increased volume, dig gullies; eventually the rills unite in streamlets and brooks, and the gullies expand into ravines and valleys; and in time streams and rivers are formed, each flowing in a gorge or valley of its own making. In this way the surface of the uplifted sea-bottom is carved into valley-systems, and the forms of the valleys determine the forms of the hills and divides by which they are bounded. It is in this way that the lands of the earth are sculptured; and the sculpture of running water produces a characteristic topography.

The earth-matter cut out of the rills, gullies, ravines, and valleys is transported by the running water into the adjacent lake or sea, where it is dropped, swept here and there by the waves, and eventually built into sheets of sediment, or formations. So long as land and sea maintain their relative position, the sediments are accumulated continuously and constitute a single formation; but if the earth-crust rises or sinks, the formation changes: If the earth-crust rises, the ocean withdraws and sea-bottom is converted into land to be sculptured into land-forms; if it sinks, the ocean advances and sediments are laid down over the land-forms sculptured by the running waters, and an unconformity is produced.

Thus in regions like the Coastal province there are two important classes of products, (*a*) land-forms, and (*b*) formations; and the unconformities separating the formations are old land-surfaces.

The development of the region is recorded in land-forms, formations, and unconformities produced in this way.

THE LAND-FORMS

Above the mouth of Rock creek, Potomac river flows in a steep-bluffed gorge cut sharply in the Piedmont plateau; Rock creek, too, occupies a narrow and rugged valley cut in a plain—a plain so definite that the eye catches its continuity and fails to note the valley save when near its brink. The lesser tributaries of the Potomac and of Rock creek flow in narrower valleys, gorges, and ravines, each proportionate to the length and strength of its stream. Thus the western part of the district is a land of sharp-cut gorges and ravines, with rugged hills between; while toward the main divides the waterways diminish in depth and the surface becomes a gently undulating plateau. And it is evident that each channel, great and small, was carved by the great or small stream now occupying it; it is evident, too, that the channels are deep because this part of the land stands high above the level of tide; and after a little study of the steepness of the valley-sides, it is evident also that the period of valley-cutting was not very long—for the steep slope is a sign of rapid stream-work.

Below Rock creek, Potomac river expands in a tidal estuary flanked by moderately steep bluffs and lined with alluvium or river-mud. Anacostia river occupies a similar but smaller trough, relatively broad and shallow as that of the Potomac;

and its bluffs rise to a moderately uniform plain in which the trough is excavated. The lesser tributaries are estuaries toward their mouths, but flow in steep-sided gorges and ravines much like those of the Piedmont toward their sources; while the divides are broad, flat plains in which the drainage systems are imperfectly developed. Thus the eastern portion of the district is a land of steep-bluffed tidal estuaries, narrowing above into gorges and ravines, with ill-drained expanses between. The history recorded in these land-forms is a little more complex than that recorded in the Piedmont: Since the valleys are proportionate in size to their streams, it is evident that all were cut by the streams now occupying them; since the head-water ravines do not unite in the broad divide-plains, and since the slopes are steep, it is evident that the land has not stood above the ocean long enough to permit the drainage-systems to extend themselves over the entire surface; and since the larger valleys are occupied by tide-water and lined with alluvium, it is evident that the land formerly stood higher than now, and has since subsided so far as to permit ocean-water to drown the larger river-cut valleys. So the land forms of the district tell of certain agencies and movements concerned in the development of the district.

THE FORMATIONS

Washington is located in a triangular amphitheater opening southward through its southern angle. This amphitheater is lined with a peculiar deposit not found over the higher bounding hills; it is composed of brown loam or clay mixed with sand, gravel, and bowlders. This is the Columbia formation. It is generally coarser below and finer above, the upper portion being used as brick-clay; and in general it is coarser toward the gateway in the wall of the amphitheater through which the Potomac enters in the western part of the city, and finer in the eastern and southern portions of the amphitheater. On comparing this deposit with the alluvium dredged out of the river-bottom there is found so close similarity as to warrant the conclusion that both were produced by the same agency—that just as the river is depositing the alluvium at the present time, especially during the spring freshets, so the Columbia formation was deposited by the river during the freshets of past ages. This conclusion involves the supposition that during the Columbia period the land stood lower than now, so that the Potomac estuary occupied the entire amphitheater. Comparison of the allu-

vium with the Columbia deposits reveals certain minor differences in the deposits, notably a larger proportion of brown loam and a larger number and size of bowlders in the ancient one; and these differences suggest that during the Columbia period the climate was colder than now, the bowlder-bearing ice-floes larger, and the thaw freshets more destructive to soil than at present. These features suffice to correlate the Columbia formation with the glacial deposits of northern United States. Thus the Columbia formation records definitely a period during which the land stood lower than now and the sea encroached further, and when the climate was colder than now. Detailed study of the formation indicates that there were two epochs of depression of the land, separated by a stage of elevation, the submergence during the earlier period being much the greater. The earlier Columbia deposits are found over the lower hills and uplands flanking the Washington amphitheater up to 200 feet above tide; the later Columbia mantles Capitol hill and other portions of the amphitheater up to about 100 feet above tide.

The distribution of the Columbia deposits is such as to indicate that the great estuaries of Potomac and Anacostia rivers and the narrower rock-bound gorge of the Potomac from Great Falls to its source were carved out in nearly their present form before the Columbia period; thus these great geographic features record a pre-Columbia period during which the land stood far above its present level so that the ocean retreated far beyond the present shore-line, probably to the great submarine scarp 100 miles off shore. This period was one of great importance in the development of the district, though it has only recently been defined through recognition of principles discovered during researches in the district. At that time the entire Coastal plain was land, so far elevated that rivers and brooks flowed swiftly across it and down its slopes, producing characteristic land-sculpture—a surface now represented in one of the strongest unconformities in the Coastal plain.

On some of the highest hills bounding the Washington amphitheater there is found a deposit of red clay and well-rounded pebbles of quartz and quartzite somewhat resembling the Columbia, but differing in that the pebbles are harder and more worn, and in that the deposit is more uniform and homogeneous; this is the Lafayette formation. Outcrops of the Lafayette are found on Good Hope hill, in the uplands about Soldiers' Home,

and on the hills toward Tenly; and most of the broad divides between the head-water ravines in the eastern part of the district and still further eastward are floored with the deposit. The structure of the deposit indicates that it was arranged by waves and currents along the shore of a shallow ocean, stretching far northward and southward; and its uniformity indicates that the deep valleys of the modern estuaries did not exist, and that it was laid down on smooth sea-bottom, a former smooth land-surface, before the post-Lafayette period of high level. It is composed of materials which are either decomposed and thus degraded chemically (the brown loam), or of great chemic obduracy (the quartz and quartzite); and the simplest explanation of its composition is that its materials were gathered by swiftly flowing streams over a land which had long been subjected to the action of chemical rather than mechanical agencies—*i. e.*, land lying low for a long period so that running water was sluggish and impotent, while decomposition of the rocks and soils went on apace.

So the Lafayette formation tells of a time when the land was low, so low that the Atlantic encroached beyond the longitude of Washington; it tells, too, of a seaward tilting of the Piedmont whereby the streams were made swifter than before, so as to tear up residuary soils and ancient quartz ledges. The distribution of the Lafayette indicates that it was originally a continuous mantle stretching from the Piedmont far seaward and northward and southward throughout the Coastal plain; but that during the subsequent period of high level it was entirely cut away along the larger and many of the smaller streams so that it is now represented only by a series of remnants on the higher divides.

Thus, the Lafayette formation is a definite record of a great subsidence and seaward tilting of the land; and at the same time it records a previous geographic condition during which its materials were prepared by chemic processes, and a subsequent geographic condition during which most of its volume was carried away by running waters.

THE COMBINED RECORD OF LAND-FORMS AND FORMATIONS

The margin of the Piedmont plateau reaching the district is a land of fairly smooth contour, albeit trenched by gorges and ravines, and its rocks yield red clays and quartz fragments on decomposition; and these conditions are in accord with the

evidence of the Lafayette formation. Thus the period of the shaping of the plateau may be correlated with the period closed by the deposition of the formation.

The great gorges of the Potomac and Anacostia and of Rock creek and other tributaries tell of a period when the land stood high above its present level; and this is in accord with the degradation of the greater part of the Lafayette, and permits correlation of the land-forms in the two provinces.

The lining of the Washington amphitheater with Columbia deposits records a period when the land stood low and when the climate was cold, and this gives a date for the correlation of local geologic history with general geologic history.

Thus the land forms and the formations, when carefully studied and interpreted, yield a record of the development of the District during the ages: The streams flowed down to the sea, the waves rolled along the shores, sediment was gathered here and deposited there, the earth-crust alternately heaved and sank; as time passed valleys were born and hills were fashioned, and the face of the land was transformed again and again; each new geography was wrought from the old, and each can be restored in mind or in picture from the study of hill and rock; and each stage in evolution was an important episode in the geographic development of the District of Columbia.

THE HISTORICAL DEVELOPMENT OF THE NATIONAL CAPITAL

By Marcus Baker*

Among all the great capitals of the world the capital of the United States stands out unique. In its origin, development, and government, Washington has no counterpart. There is but one Washington. That the National Capital is unlike other cities in the United States is matter of common observation and remark. Its wide, asphalt-covered avenues, its shaded streets, its parks, and public statues—these outward shows usually first arrest attention and excite comment. The roominess of the streets and the leisurely air of those who use them are also often

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remarked on by visiting strangers. The smoothness and spaciousness of the highways seem to be a perpetual source of delight, while the want of commercial bustle and rush and turmoil in the streets is to many a visitor visible evidence of the laziness and indifference engendered by the public service. Whether this judgment be wise or otherwise, it is not for those judged to determine; yet we know that though first impressions are prone to last, it is not because of their accuracy; and from judgments we often learn more of the quality of the judge than of that concerning which he pronounces judgment.

Most of our large cities are given over to manufactures and commerce. The energy of the citizens is given to making things, to transporting them, to buying and to selling. Business activity and prosperity, to the resident of such cities, means crowded and noisy streets, filled with endless streams of men, women, and traffic, horses, trolley cars, cobblestones, policemen, street fakirs, big wagons, little wagons, automobiles, with fake extras of yellow journals shouted above all the din. To those whose lives are spent in such surroundings, Washington seems dull and stupid.

Washington is now nearly a century old, it having been first occupied as the seat of government in 1800. It was on June 15 of that year that the public offices were first opened, and on November 22 following that Congress for the first time met in Washington.

At the close of the Revolution, when Congress was in session in Philadelphia, it will be remembered some of the unpaid soldiers grew impatient at the delay in settling their accounts. To hasten a settlement and stimulate what they deemed a dawdling and lazily deliberative Congress to prompt action, these soldiers made a threatening demonstration about the old Statehouse where Congress was then in session.

Just as the present war with Spain has suddenly and profoundly affected the thinking, the outlook, and the points of view of all who think, so this little demonstration to hasten the payment of money due taught Congress, the apt pupil, a lesson which the teacher, a mutinous soldiery, neither knew nor dreamed of. Our forefathers had chafed under the presence and support of an army maintained against the citizens at the cost of the citizens and in the interest of the sovereign. When their own citizen soldiery grew mutinous, a new view suddenly appeared and with it a new danger. Out of this new view and from this real

or supposed menace came the decision, thoughtfully and resolutely taken, that the seat of government of the *United* States must be where only those United States have exclusive jurisdiction and control. This new created State, this then small star in the galaxy of nations, was designed to be and its founders believed it was to become a great nation. So believing, they deliberated and determined that it should have a permanent home of its own, where its laws could be made, interpreted, and executed without improper interferences or influence of any kind or from any source. The conclusion was to select a tract and build a permanent home as the seat of government. Most capitals have been established or have grown up in towns or cities already existing. Not so the city of Washington. When, in April, 1789, President Washington first entered upon his high office, there was no city of Washington. Yet there was to be a "Federal City." The Constitution, framed and signed in 1787, provided that Congress might "exercise exclusive legislation . . . over such District (not exceeding ten Miles square) as may, by Cession of particular States and Acceptance of Congress, become the Seat of the Government of the United States."

Under this authority Congress, by a law enacted on January 16, 1790, and amended July 16 following, selected the present locality on the banks of the Potomac.

Down to 25 years ago there was talk from time to time of moving the capital to a more central location. The discussers rarely or never, however, gave evidence of any acquaintance with the labor involved or the traditions of the compromise which resulted in the selection of the present site. Whoever will take the trouble to learn what it cost to do this will be either a very bold or a very foolish man to hope or expect that a removal of the capital is possible.

The original grant by Virginia and Maryland, accepted by Congress in 1790 as the permanent seat of Government, consisted of a tract of 100 square miles, lying on both sides of the Potomac river. Under the direction of three Commissioners, appointed by Washington, this tract was surveyed by Major Andrew Ellicott in 1791. The boundary was traversed, chained, and cleared of timber and a topographic map prepared of the 100 square miles comprised within these boundary lines. As the survey approached completion in the autumn of 1791, Ellicott asked the Commissioners for the title or name to go on the map; whereupon the Commissioners formally passed on the

matter. They answered, "The City of Washington, in the Territory of Columbia." Thus the "City of Washington," as yet an airy nothing, but with a local habitation in the "Territory of Columbia," now received a name. This was in 1791. Yet it took time to get the names into use. The imaginary city continued to be referred to chiefly as a jest under the old descriptive phrase, *Federal City*. When in 1792 the boundary monuments were set along the Maryland part of the District boundary line the word Maryland was cut upon that side of each stone which faced Maryland, but upon the side which faced what we now call the District of Columbia the word Columbia does not appear. Instead of it there appears in clear, large, and deep-cut letters the words "*Jurisdiction of the United States.*" Obviously this fact, rather than a name, was uppermost in the minds of the Commissioners in 1791. And this fact is still unique in the history of all capitals. Congress legislates for the District of Columbia absolutely, and thus we have for the national capital this curious anomaly. It is legislated for, taxed, managed, controlled, and governed by the united voices of all the voters of the United States except its own. The citizens of Washington itself are the only ones in the United States who are by law deprived of all voice as to the management or control of Washington affairs. And what seems stranger still, these strange Washingtonians are well content with this hard fate, and would, it is believed, refuse to change it even if they had the power.

Washington, it must be remembered, differs from other cities because it was intended to be different. Its site, when choice was made, is described as a wilderness, and for more than half a century did not cease to be ridiculed as such; and the plan of the city was completely drawn out on paper and marked out on the ground before any buildings appeared—just as happens with modern boom towns, but with this difference: In the boom town the real estate speculation is the main motive; in the founding of the nation's capital it was only an incident, and an incident which Jefferson strove to minimize by letting out either none or misleading information as to plans for public buildings and "appropriations," as tracts reserved for the general government were called.

The plan for the city was drawn up by a French engineer, Major Pierre Charles L'Enfant, and his plans were doubtless examined, criticised, and approved by Washington. His original manuscript map, now faded and worn, is in the War Department

in the custody of the Chief of Engineers. Some ten years ago this now precious manuscript was taken to the Coast Survey office, where it was carefully traced, photolithographed, and published. Copies of it are (or were) obtainable at the Coast Survey office. This map may be said to represent Washington in embryo. Great praise is due to the proud L'Enfant for the part he took in designing the city; but his zeal, his pride, and his impetuosity soon brought a rupture; his services were dispensed with; the pay tendered him was spurned as unworthy of him. His remains rest in an unmarked grave in private grounds in the northeastern suburbs of the city. The relative credit due to L'Enfant and to Ellicott for the part taken by each in designing and laying out the city is still a mooted question, and the disagreement as to this is doubtless the reason why to this day no suitable public recognition of their services has ever been made.

The interval between 1791 and 1800 was spent in erecting public buildings—"the President's House," "the Congress House," and others. In 1800 the government records were all brought over from Philadelphia. On June 15 the public offices were first opened. Thus June 15, 1900, will be a suitable day for a public holiday in Washington for commemoration and retrospect. Men still live in Washington whose fathers served the United States in Philadelphia and who followed that little bunch of records—the entire archives of the Republic—to the imaginary city in the real wilderness on the Potomac, nearly a century ago.

According to the census of 1800, the "inhabitants of the city of Washington numbered 3,210 souls." Down to 1850 or later Washington continued to be a great straggling village. It grew, but it grew slowly. The foreign ambassador whose assignment brought him to Washington was prone to feel that he was banished. No pavements, no water supply save from pumps in wells scattered here and there, no sewerage system, no street cars, few schools and poor, and distances "magnificently great." Indeed, Washington's greatness still existed chiefly in the imagination of its projectors. No manufactures brought workmen here; it was not a commercial center. Indeed, it might be likened to a great straggling college town, where all life is derived either at first or second hand from the college. So here there grew up about the government offices boarding-houses for the transients and shopkeepers to supply the boarding-houses.

The war of 1812 had made little impress on the capital. The

British troops occupied the city for a few hours in August, 1814, burned the White House, set fire to the Capitol, and retired. But the civil war, 1861–1865, had a very different effect and made a lasting impress. Washington for four years was one great military camp and hospital. A cordon of earthworks many miles in extent surrounded the city. Bluecoats were everywhere, and the passing of endless trains of bronzed veterans, of sick and wounded, of artillery, of supplies, was too common a sight to attract either notice or comment. Into this camp there came by railroad one evening Mrs Julia Ward Howe. Long abominating slavery, she saw in all this stern turmoil the fruition of the abolitionists' hope, and that out of this war was to emerge freedom for black and white alike. From the car windows could be seen the camp-fires stretching miles away. After making a round of visits to various camps, the following day she returned to her hotel, her heart all on fire, and there wrote that immortal Battle Hymn of the Republic, beginning—

> Mine eyes have seen the glory of the coming of the Lord,
> He is trampling out the vintage where the grapes of wrath are stored.

Recalling the circumstances under which the lines were penned, we can the better understand such a line as this:

> I have seen Him in the watch-fires of a hundred circling camps.

But the war ended at last. During it even Pennsylvania avenue, a street now as widely and as favorably known as any in the world, was at times a veritable mud-hole, wherein artillery and wagon trains sometimes stalled. The "White lot" and the "Monument grounds" ceased to be used for slaughtering cattle for the army; the great mule-drawn wagons no longer went daily to the Capitol for the tons of bread baked in the little rooms under its west steps; the churches no longer housed the war-mangled and disease-stricken, and the war scars about the city began quickly to heal. The unsightliness of the half-finished dome of the Capitol faded with its completion. The tract of neglected undergrowth and wild woods, with its surrounding dilapidated picket fence, was transformed into the park which now faces the east front of the Capitol. The Washington monument, which all during and for years after the war stood as an unsightly stump surmounted by wooden scaffolding, grew to a stately shaft, a thing of beauty, and the débris and litter which for twenty years or more had cumbered the ground at its base

at last vanished. The old system of schools gave way to the new and in 1876 Washington for the first time had a high school. Its Baptist college, now Columbian University with 1,000 students, dates from 1821, while the Jesuit college in Georgetown is yet older.

The unique character of Washington and of its attractions steadily grows. Little by little with passing years men and women so circumstanced that they may live where they will select Washington for a home. The opportunities it affords for much of all that makes life attractive have been well expressed by one who has come to abide here: "Four years in Washington to one who will take what may be had for the taking, much less the asking, is equivalent to a college education."

GEOGRAPHIC WORK OF THE GENERAL GOVERNMENT

By Henry Gannett,

United States Geological Survey

The United States is engaged, through the agency of a number of bureaus and departments, in extensive geographic work, both within its own borders and in various parts of the world. The results of this work are embodied in maps, charts, and reports, which furnish a vast amount of information; indeed, these form the principal original source of information regarding the geography of the United States in all its aspects—topographic, climatic, geologic, biologic, and industrial. Many of these reports and maps are furnished free, while others are, under the law, to be obtained only by purchase.

The following are the principal bureaus and departments which are engaged in geographic work:

Coast and Geodetic Survey.
Hydrographic Office, U. S. Navy.
Engineer Corps, U. S. Army.
Geological Survey.
General Land Office.
Weather Bureau, Biological Survey, and other divisions of the Department of Agriculture.
Smithsonian Institution and its dependencies.
Fish Commission.
Light-house Board.
Bureau of American Republics.
Intercontinental Railway Commission.

GEOLOGICAL SURVEY

The Geological Survey is charged by law with the examination of the geological structure, the mineral resources, and with the classification of the public lands of the United States. It was organized in 1879, upon the discontinuance of the Hayden, Wheeler, and Powell surveys of the Rocky Mountain region.

As the successful prosecution of the work confided to it required the possession of accurate topographic maps, the preparation of such maps was commenced in 1882, and a large proportion of the appropriations for the Survey have been devoted to this work.

The work of the Survey, as at present organized, is as follows:

The preparation of topographic maps.
The preparation of geologic maps.
The technical and statistical study of mineral resources.
The study of the water resources of the arid region.
The examination of the forests of the west.
Chemistry and paleontology as accessories to the geologic work.

The Geological Survey began, in 1882, the construction of a topographic map of the country. The work has now been in progress 16 years, and about 650,000 square miles have been mapped. The areas shown on these maps are scattered widely over the country, and represent a great variety of topographic features, and the map sheets can be used to illustrate topographic forms. These maps differ in scale. Some of them are on the scale 1 : 62,500, which is very nearly one mile to one inch. Another scale is 1 : 125,000, which is very nearly two miles to one inch, and a third scale is 1 : 250,000, or nearly four miles to one inch.

Sheets.—For convenience this map is published in sheets of nearly uniform size, the portion of the sheet covered by the mapping being usually 17½ inches in height, with a breadth ranging, according to latitude, from 12½ to 15 inches. Each sheet on the scale 1 : 250,000 includes what is commonly called a "square degree," an area one degree in extent in each dimension (for instance, latitude 40° to 41° and longitude 90° to 91°). A sheet on the scale 1 : 125,000, which is of approximately the same size, includes a tract of country 30′ in latitude by 30′ in longitude, or one-fourth of a square degree, and a sheet on the largest scale, 1 : 62,500, includes an area 15′ in latitude by 15′ in longitude, or one-sixteenth of a square degree.

Contents.—This map shows features which, for convenience,

may be classed in three groups, viz: water features, including the sea, lakes, ponds, rivers and other natural streams, and canals and irrigation ditches; land features, including mountains, hills, and valleys; and cultural features, or the works of man, such as towns and cities, roads, railroads, boundaries, and names.

Water features.—All water features are shown in blue, the smaller streams and canals in full blue lines, and the larger streams, lakes, and the sea by wavy blue lining. Certain streams, however, flow only a part of the year, being dry at other times, and such streams are shown not by full lines, but by dotted blue lines. Fresh-water marshes and swamps are shown by broken horizontal lining, interspersed with tufts of blue. Salt-water marshes are shown simply by horizontal blue lining.

Culture.—The works of man are shown on the map in black, in which color also is printed the lettering. They are enumerated, and the characters used to represent them are given in what is called the legend at the side of the map.

Land features.—The land features, commonly called the relief, include all the variations of the surface, the alternation of mountain and valley, plateau and canyon, hill and plain. These features are represented by means of contour lines, or lines of equal elevation above the level of the sea. The line of sea-coast itself is a contour line—the line at zero elevation. The contour line at, say, 20 feet above sea-level is the line which would be the sea-coast, if the sea were to rise or the land to sink 20 feet. Such a line would run back up the valleys and forward around the points of hills and spurs. On a gentle slope this 20-foot contour line would be far from the present sea-level, while on a steep slope it would be very close to it. So a succession of these contour lines, one above another, with equal vertical spaces between them, would, if they were far apart on the map, indicate a gentle slope; if they were close together, a steep slope; and if they were run into a single line, as if they were on top of one another, they would indicate a cliff. The contour lines of any region, when represented on a map, show the elevation of any part of the map above the sea. They also show the slopes of the ground and the forms of the mountains, hills, and valleys; in short, of all the relief features. These contour lines are printed in brown.

The geological work proper of the Survey consists in a study of the rock formations and in the mapping of their extent and form. The results are published in annual reports, in monographs, and in geological folios.

The Division of Hydrography in the Geological Survey has in charge the examination of the water resources of the United States, both above and under ground. Measurements are made of the amount of water discharged by various rivers in different parts of the United States, and from the facts thus obtained computations are had of the daily flow, thus giving the fluctuations through periods of seasons and years. At the same time, a careful study is carried on in certain localities of the geologic structure with especial reference to the ability of the rocks to receive and transmit water, and, where practicable, maps are prepared showing the depth of the principal water-bearing strata, so that it is possible for any person to form a fairly definite idea as to the probability of obtaining supplies for various purposes. The economic bearing of information of this character is readily recognized when consideration is had of questions of development of water-power, the supplying of cities or country homes with water, or the extension of agriculture through irrigation. In the west, where the farmer must apply water artificially before a crop can be raised, it is obvious that the supply must be ascertained before a great extension of tilled land can be possible. We know that the amount of water available in the arid region is far less than the demands made upon it; so much so that it may be said that all land value depends upon the water supply. The United States, being the great landowner, has before it the problem of the reclamation of this vast extent of fertile country, and each citizen, as part owner, is concerned in seeing that the largest use is made of the water.

The Forest Division is engaged in making an examination of the forest reserves in the west, with a view to learning the amount of timber contained therein, the distribution of species, the conditions of growth, and a large group of facts essential for the proper management of these reserves. It is engaged further in the collection of statistics for standing timber throughout the west.

The first report of this division will appear as a part of the Annual Report of the Survey for the past year, and will be accompanied by a portfolio of maps.

The Division of Statistics collects the statistics of production of metals and minerals and publishes the results in an annual report.

The publications of the Survey consist of atlas sheets and other maps, geological folios, annual reports, bulletins, and monographs. The atlas sheets are sold individually at five cents, or

two dollars per hundred. Other maps are sold at different prices, depending upon their size. The annual reports are free to applicants. The monographs and bulletins are, under the law, sold at certain stated prices.

SMITHSONIAN INSTITUTION AND ITS DEPENDENCIES

The Smithsonian Institution was created in 1846, under the provisions of a bequest by James Smithson, and has since been maintained by use of the interest on the sum originally bequeathed and the various additions made subsequently. Accordingly the work of the Institution is not conducted under the auspices of the government, though the fund is administered by a regency appointed by the government, and different lines of scientific work undertaken by the government have been from time to time conducted under the direction of the Institution.

During its earlier years the Smithsonian Institution gave much attention to the encouragement of geographic work and began a series of meteorologic observations now continued in the Weather Bureau. It also promoted geologic work and aided in the establishment of the Federal Geological Surveys. Throughout it has been the policy of the Institution to initiate lines of scientific work of public importance, to maintain them until their importance came to be recognized, and then to transfer them to the general government. In carrying out this policy the Institution has contributed in large measure to the development of the scientific institutions of the National Capital.

There are now three federal bureaus connected with the Smithsonian Institution, but maintained by federal appropriations, viz., the United States National Museum, the National Zoological Park, and the Bureau of American Ethnology. The National Museum issues an annual report and other publications relating to its work and the collections made and displayed, while the superintendent of the Zoological Park issues an annual report in connection with that of the Institution. No surveys or extensive field researches are made by these bureaus.

The Bureau of American Ethnology is engaged in researches relating to the American Indians, its operations extending over the United States and other American territory, and the distribution of the aborigines being mapped from time to time. It issues annual reports, which are well illustrated and commonly accompanied by maps; these are distributed chiefly by Congress.

THE CENSUS

The Census Office is a temporary organization created for the purpose of taking the decennial census. The census obtains statistics regarding population, including age, sex, race, nativity, and, in the case of native-born, the state of birth and the occupations of the people; it obtains statistics of illiteracy and education, of mortality, of the insane, deaf, dumb, and blind, and other social statistics; it obtains statistics of industries, including under the head of agriculture the number, size, and value of farms, the amount of cultivated land, the magnitude of all principal crops, amount of live stock, etc.; under the head of manufactures the number of each kind of establishments, with their capital, material used, product, and employés; under the head of mining it obtains statistics of the number of mines and their character and product; under the head of transportation it obtains statistics concerning the operations of railroads (including street railroads), canals and navigation, coastwise and on our lakes and rivers. The results are published in a series of quarto volumes, and are summarized in a compendium and in an abstract. They are further summarized, mainly in pictorial form, in a statistical atlas. All these publications can be obtained on application to the Secretary of the Interior.

HYDROGRAPHIC OFFICE

This is a branch of the Navy Department and is in charge of a naval officer, known as the hydrographer. The function of this office is to prepare from the best available sources and to publish charts of foreign coasts for the use of our navy and the merchant marine.

Besides this work, the office is engaged in a study of terrestrial magnetism and its distribution over the earth, as an aid to the navigator, and in the study of marine meteorology and ocean currents.

The navy has charted great extents of coast of barbarous nations, and the results have been published by this office. It has also made valuable contributions to our knowledge of the sea bottom, particularly in the Gulf of Mexico and Caribbean sea, by deep-sea soundings.

The charts published by this office are sold at prices differing with the size of the chart.

GENERAL LAND OFFICE

This office is charged with all matters relating to the disposal of the public lands. In pursuance of this duty its first function is to subdivide these lands into parcels suitable for sale or other mode of disposition. The method of subdivision of the public lands has been, in its main features, a consistent one from the beginning. The land is divided by survey into townships six miles square, and each of these into sections of one square mile. These sections may be in turn subdivided. This work is done in the main by contract, at certain rates per linear mile. The surveyors are required to prepare and file maps or plats of the townships subdivided, and thus there has accumulated in the Land Office a vast body of maps, representing an area of over a million square miles. These maps are upon the uniform scale of two inches to one mile, but they are of varying degrees of excellence. From these plats the Land Office compiles and publishes state maps, at present upon a uniform scale of twelve miles to an inch, and these maps form the basis of most of the atlas maps in use. Besides this series the Land Office compiles a map of the entire United States, upon a scale of about forty miles to one inch. The state maps can be obtained upon application to the Commissioner of the General Land Office. The United States maps are sold at a price of $1.00.

Besides this work of subdivision, with the resulting maps, this office superintends the survey of the state and territorial boundaries.

THE LIGHT-HOUSE ESTABLISHMENT

The Light-house establishment is in charge of the Light-house Board, under the Secretary of the Treasury. Its duties are to maintain upon the coast, lake shores, and navigable rivers a system of lights and buoys for the guidance of mariners.

COAST AND GEODETIC SURVEY

This organization was created by Congress in 1807, but little work was done under this act until 1832. Since that time the Coast Survey has been in continuous operation. It is charged with the survey of the Atlantic, Gulf, and Pacific coasts of the United States, including rivers to the head of tide-water or ship navigation. It has carried on extensive deep-sea soundings, together with temperature and current observations, especially in

that part of the Atlantic traversed by the Gulf stream. It conducts also magnetic observations for the determination of the direction, dip, and force of the earth's magnetism, and measures the force of gravity by means of the pendulum. It is carrying on accurate triangulation in the interior of the country, having already completed a belt across the continent from east to west, together with a large amount of similar work done in aid of state surveys. In addition to this triangulation in the interior, lines of accurate levels have been run over many thousands of miles.

The results of this work are published in the form of charts of the coast upon various scales, upon some of which the relief is represented by hachures, upon others by contours. These charts are sold at prices differing with the size of the chart. There are also published annual reports, in which are contained papers upon geographic subjects pertaining to the work of the Survey.

CORPS OF ENGINEERS, U. S. A.

The War Department carries on a great variety of geographic work, mainly through its Corps of Engineers. By this office has been executed a complete survey of the shores of the Great Lakes and of the St Lawrence. The charts resulting from this survey are upon various scales, dependent upon the needs of navigators, and are sold at prices differing with the size of the chart. The Mississippi and Missouri River Commissions are in the nature of advisory boards to the Chief of Engineers. By the Mississippi River Commission that river has been mapped from its mouth far up into Illinois and the results published upon various scales, the largest being 1 : 20,000, in contours; another on a scale of one mile to an inch, while the whole alluvial region of the Mississippi, from Cairo to the Gulf, has been issued in one large map, on a scale of four miles to an inch, in eight sheets.

The Missouri River Commission has mapped that river from its mouth to the Three Forks, in Montana, publishing the maps upon various scales, ranging from one mile to an inch upward.

The Engineer Corps has mapped also the Ohio river from Pittsburg to its mouth, the Arkansas, Red, White, and Yellowstone rivers. Copies of these maps can be obtained by application to the Chief of Engineers.

To this organization has been entrusted also the survey of parts of our international boundary.

Between 1867 and 1878 extensive surveys and explorations of the west were made under Maj. George M. Wheeler. Of many parts of the west the maps prepared by this organization are the only ones to be obtained. They were published upon a scale of four and eight miles to an inch, in hachures. These maps are now extremely scarce and difficult to obtain.

The Corps of Engineers is charged with the improvement of harbors and rivers, in aid of navigation, and in pursuance of this work it has carried on extensive surveys, but mainly of small areas. The resulting maps are published in the annual reports of that office, which can be obtained from the Chief of Engineers.

WEATHER BUREAU AND OTHER OFFICES AND DIVISIONS OF THE DEPARTMENT OF AGRICULTURE

The primary function of the Weather Bureau is to predict the weather. This work requires the constant maintenance of hundreds of meteorological stations, scattered over the country, at which continuous observations of pressure, temperature, rainfall, humidity, and winds are made, thus furnishing the material for an exhaustive description of the climatology of the country. It involves also an exhaustive study of the science of meteorology. It includes also a close watch of the great rivers for the purpose of predicting floods.

The publications of this office are voluminous. They consist of a weather map, published daily, showing the climatic conditions prevailing in all parts of the country on that morning; weekly weather maps, showing summaries of the conditions; a monthly weather review and annual reports. In addition to these, bulletins are published containing treatises on meteorologic and climatologic subjects, summaries of statistics, etc. All these may be obtained on application to the Chief of the Weather Bureau.

Besides the Weather Bureau, the Department of Agriculture contains a number of divisions and offices, much of whose work is geographic. The Biological Survey, the Divisions of Forestry, Botany, Agrostology, Entomology, and Pomology are concerned, in great part, with the distribution of life in the country, and in so far their work is geographic.

The Biological Survey studies the geographic distribution of animals and plants, and maps the natural life zones of the country, besides investigating the economic relations of birds and mammals.

The Division of Forestry is engaged in the study of sylviculture, and in the management, protection, and utilization of our forests.

The Division of Agrostology investigates the natural history, geographic distribution, and uses of grasses and other forage plants.

The Division of Botany investigates the purity and value of seeds, methods of controlling the spread of weeds or preventing their introduction. It studies the native plant resources of the country.

The Division of Entomology studies insects injurious to vegetation, their distribution and spread, and the methods for reducing their ravages.

The Division of Pomology has to do with the culture of fruits.

The publications of this department are of three classes: first, serial publications; second, scientific and technical reports. These two classes are issued in limited editions and are not intended for general distribution, being particularly designed for libraries, institutions of learning, and scientific students. Third, popular bulletins, which are issued in large editions and are sent free to applicants. Lists of the publications are sent on application.

FISH COMMISSION

This office was created for the purpose of maintaining and increasing the supply of food fishes, both upon our shores and in our rivers. As a necessary adjunct to this work, exhaustive studies are being made of the life history of fishes and of their distribution. The publications of the Fish Commission consist of an annual report.

BUREAU OF AMERICAN REPUBLICS

The function of this Bureau is to obtain and publish commercial information concerning the American republics. Its publications consist of handbooks of these countries, a monthly bulletin containing the latest information regarding their resources and commerce, and a commercial directory.

INTERCONTINENTAL RAILWAY COMMISSION

This Commission was formed for the purpose of examining the best routes for an intercontinental railway to connect the United States with the republics of Central and South America. Its work is completed and reports and maps will shortly be issued.

THE GEOLOGIC ATLAS OF THE UNITED STATES

In the course of his study of the elements of greatness of nations, Buckle concluded that there are three normal stages in national development—the stage of agriculture, followed first by the stage of manufacture and eventually by the stage of foreign commerce. Buckle's conclusions were based on the study of nations confined by territorial limits, and so situated as to derive support through commerce with other nations of different resources and (generally) inferior intelligence and industry. Since Buckle's time the population of the world has increased and spread far beyond his realization, and new factors have been introduced in the problems of statecraft. This is particularly true of the First Republic of America, which controls a vast territory and possesses within itself nearly every necessary resource. By reason of the new conditions, the actual history of this republic has become a great object lesson in statecraft; and the experience of the nation, built as it were on a new foundation, has wrought out conclusions of even weightier significance than those of Buckle. One of these conclusions is that the nation desiring to progress well in the race for success must have within itself the territory requisite for agriculture, the resources for manufacture, and the facilities for extended commerce, all growing up together and all fostered by a single people united in interest and purpose. Another conclusion wrought out by national history is related to those formulated by Buckle; it is that national progress is assured by increase in intelligent activity on the part of masses and leaders alike. With the normal increase of population and of national intelligence, the economic problems and the means of meeting them gradually change; intensive agriculture makes "two blades of grass grow where one grew before" and converts coarse vegetal tissue into richer animal food, wholesale manufacture diversifies industries, and abundant commerce at once differentiates the individuals and welds their interests into perfect solidarity. As agriculture grows intensive through more intelligent cultivation, so all industries are made intensive by pressure of need and reaction of intelligence; and current thought adjusts itself to constantly changing conditions.

A significant expression of the national growth of the United

States is found in the development of geographic problems and results. In earlier decades the geographic work was exploratory, and bent toward the discovery and conquest of unknown or little-known territory. As time passed, more and more attention was given to the resources of the newly discovered valleys and plains, mountains and forests; and, now that the exploration of our territory is complete, the efforts of the pioneers are devoted to discovery of new resources. This change in purpose, albeit gradual, cannot be too strongly impressed. The earlier work was areal and largely limited to the surveys of the land, the present work has a vertical element reaching toward the resources of the rocks below and the powers of the air and vapor above; the earlier studies related to materials, the present investigations relate to natural powers and potentialities—in brief, the one sought to subjugate matter, the other seeks to make conquest of force. Various instrumentalities of national character have contributed toward this transformation in beneficent activity, but none have contributed more, especially during the last dozen years, than the U. S. Geological Survey.

During the earlier years of its existence the Geological Survey devoted chief attention to topographic surveying and mapping, the maps being designed for subsequent use by the geologist; and the bureau came to be known favorably throughout the country and the world by reason of the extent and excellence of the topographic maps. During this period a corps of geologists were employed in researches designed partly for the development of a system of classification adapted to the subsequent geologic mapping. The two branches of the work were judiciously coördinated by Director Powell, so that when the topographic surveys were sufficiently advanced in different districts the geologists were provided with adequate classific systems, and were able to proceed at once to effective geologic work; and this coördination has been continued by Director Walcott with the normal increase in production of geologic maps.

The plan of publication adopted by the Survey marks an epoch in the history of practical scientific work; for it is designed to bring the results of the most advanced scientific research within the reach of every citizen of the nation, and within the mental grasp of every graduate from the public schools of America; the plan represents more fully than any hitherto devised in any country the idea of distributing broadcast among the people the rich boon of scientific knowledge. Only a gene-

ration ago several of the world's intellectual leaders occupied themselves most laudably in teaching the beneficence of science and its freedom from mystery; today the teaching has become an object lesson through the Geologic Atlas of the United States.

An example—it may not be invidious to say the finest example to date—of the "atlas folios" issued by the Survey is the Pueblo Folio, by G. K. Gilbert.* Like the rest of the series, it is a thin folio, 21¾ by 18½ inches, bound in a moderately stiff manilla paper. The first cover page bears an index map showing the position of the area represented, and also of other published folios, with respect to considerable adjacent territory; while the second and third cover pages contain an elementary "Explanation" setting forth in simple language the principles and methods of topographic mapping, and the classification and conventions used in the geologic mapping. This text is general, equally applicable to all atlas folios, and signed by the Director. Like most of the other examples, the folio proper comprises (1) a preliminary descriptive text, followed by (2) a topographic atlas sheet representing the "quadrangle" (or tract) to which the folio is devoted, (3) a geologic map of the same tract, (4) an economic map of the tract showing the distribution and indicating the value of the important resources, (5) a sheet of sections exhibiting the structure of the tract, and (6) special supplementary illustrations. In this instance the special illustrations comprise (*a*) a lithographic reproduction of a model showing the deformation of the tract during a particular epoch, (*b*) a map showing the distribution and depth of phreatic water within reach of artesian and pumping wells, (*c*) a series of columnar sections showing in detail the structure and thickness of the beds, and (*d*) illustrations of typical fossils and rock-structures. Like other folios of the series (of which this is No. 36), the work is distributed to certain libraries and other depositories, and is sold, on application to the Director of the Survey, for 50 cents.

The "Description of the Pueblo Quadrangle" forming the authorial text of this folio is especially noteworthy as representing the work of one of the foremost geologists of the world in a peculiarly instructive geologic province. It begins with an introduction in which the terminology is explained. This is followed

* Department of the interior | United States Geological Survey | Charles D. Walcott, Director | Geologic Atlas | of the | United States | Pueblo Folio | Colorado. [Index map, list of sheets, etc.] Washington, D. C. | Engraved and printed by the U. S. Geological Survey | Bailey Willis, Editor of Geologic maps. —— S. J. Kübel, Chief Engraver | 1897

by a summary account of the geography, including climate and vegetation, agriculture, etc. Next follows an account of the general geology, including a history of physical changes, set forth verbally and graphically. In this division of the work the characteristics of the formations are described, the sources of materials are considered, the subsequent alterations recorded in texture and structure are investigated, and the great orogenic and epeirogenic movements that produced the majestic Rocky mountains and (especially) the broad plains at their base are interpreted—*i. e.*, the phenomena are treated both locally and comparatively, and in remarkably luminous and attractive fashion. The formations range from recent alluvium through earlier Pleistocene, Neocene, Cretaceous, Juratrian, Carboniferous, and Silurian to the Archean nucleus exposed in the ranges; and there were several periods of deformation, the movements of which have been analyzed and clearly set forth. In describing the formations and discussing the deformations full recognition is given to the principles of geomorphy and to homogenic correlation, and the history of the tract is thereby made clear and definite. There is a final chapter on economic geology in which the resources, including phreatic water, are fully described.

This synopsis merely indicates the scope of a notable publication; it does not and cannot give any adequate idea of the high scientific and educational value of a great work which can be properly appreciated only after examination. It is not too much to say that this atlas folio by itself would, in the hands of a competent teacher, serve as a complete introduction to geology, by means of which any pupil might gain an elementary knowledge of the science; or that in the hands of a competent teacher (or, indeed, of an intelligent student without a teacher) within the tract described the work would be more serviceable than any manual or text-book of geology ever written. The publication of these atlas-folios representing particular tracts in all parts of the country is bound to revolutionize geologic teaching quickly, completely, and permanently. W J M.

At the annual meeting of the Royal Geographical Society, held recently in London, the Founders' Medal of the Society was conferred on Dr Sven Hedin for his explorations in Central Asia, and the Patrons' Medal on Lieut. Robert E. Peary, U. S. N., for his work in Greenland.

THE TOPOGRAPHIC ATLAS OF THE UNITED STATES

"In 1882 the United States Geological Survey began the construction of a topographic map of the country. The work has now been in progress fourteen years, and about 600,000 square miles have been mapped. The areas shown on these maps are scattered widely over the country and represent a great variety of topographic features, and the map sheets, with the aid of descriptive text, can be used to illustrate topographic forms. This led the Director to propose the publication of an educational series of folios, for use wherever geography is taught in high schools, academies, and colleges. Authority for their publication and sale was granted by Congress in an act approved March 2, 1895. . . . The first folio of the series presents on ten maps illustrations of some of the simplest and most characteristic types of topography to be found in those parts of the United States which have thus far been mapped. Succeeding folios will illustrate more complex forms."

So Henry Gannett, Geographer of the United States Geological Survey, introduces an illustrated treatise in folio form on the "Land Forms of the United States."*

When geographic exploration brought to the knowledge of men the unparalleled Grand Canyon of the Colorado and the picturesque plateau country adjacent, the way was prepared for the discovery of new principles in geographic development; in good time Powell descended the Canyon, and he and his collaborators surveyed the plateau country, and as the work progressed the "baselevel of erosion" was recognized. The idea quickly took root, and grew into one of the fundamental principles of earth-science; spreading eastward into provinces already reconnoitered or surveyed, it was found to afford a new means for interpreting earth-history, and thereafter the later stages in the geographic development of the continent were read from land forms as well as from fossil plants and animals. The principle

* Department of the Interior | United States Geological Survey | Charles D. Walcott, Director | —— | Topographic Atlas | of the | United States | Physiographic Types | by | Henry Gannett | —— | [List of Contents, etc.] | Folio 1 Physiography | Washington, D. C. | Engraved and printed by the U. S. Geological Survey | S. J. Kübel, Chief Engraver | 1898.

was applied in southeastern United States, where the important episodes in continental history are clearly recorded in the plateaus and canyons of the Piedmont region, and where the minor movements are recorded in unconformities separating the deposits of the Coastal plain; it was applied most successfully in New England and elsewhere by Professor Davis, who reads earth-history from topographic maps. Within a dozen years the principle has been widely recognized among investigators, and has given birth to a science—Geomorphology or the New Geology. Thus far this line of learning has mainly been confined to a limited number of original investigators and teachers in high grade educational institutions, and has lain beyond the reach of the general school and the citizen; but now Mr Gannett's treatise, issued by a public office, brings this distinctively American advance in science within reach of the American public.

The atlas comprises ten maps, of which the first three are devoted to the now well-known stages in topographic development—youth, maturity, and old age. The fourth illustrates a rejuvenated region, typifying the Piedmont plateau. The fifth map represents a young volcanic mountain, its subject being our magnificent volcanic cone, Mount Shasta. Moraines and drumlins, representing characteristic phases of ice-work, are shown on the sixth and seventh sheets, and a fiord coast, with its picturesque record of ice-work half drowned in ocean, forms the subject of the ninth sheet. The two remaining sheets illustrate river flood-plains and a barrier-beach coast. The text includes an exposition of the conventions used in topographic mapping, and a full description of each of the sheets with a fuller interpretation of its features as records of geographic development.

The issue of this folio marks an epoch in geographic teaching. Hitherto teachers have been limited in their work to glittering generalities in the books, or to the maze of little-understood realities in their sight; but now comes a series of American illustrations, shown in such detail that any teacher may correlate the features with those of his own landscape, and these are interpreted by the hand of a master so clearly that even the average pupil cannot fail to read aright.

The atlas folio may be obtained at the nominal price of 25 cents on application to the Director of the Geological Survey.

W J M.

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